

Impact of Sparkling Water Droplet: preliminary investigation

L. Araneo*¹, S. Musmeci^{1,2}, M. Marengo²

¹Politecnico di Milano, Italy

²University of Pavia, Italy

*Corresponding author: lucio.araneo@polimi.it

Abstract

The use of high-frequency cameras is a fundamental tool in the study of two-phase fluids such as sprays and droplet behaviour. This paper presents the development of a neural network based on different interpolation criteria to classify images, extract contours and define geometric features in the presence of noise.

Introduction

The dynamic of droplets impacting on dry or wet surfaces is of great importance in many scientific fields and technological applications. The effect of many different parameters have been studied in a variety of studies, including droplet size and velocity, fluid composition and properties, surface material and geometry. In the present work the droplet used are composed either of pure distilled water, or of water with CO₂ dissolved in it, to compare the outcome of their impact on two different surfaces.

Method

Distilled water at 10°C, either pure or saturated with CO₂ at 3bar, is used to produce droplets of about 3 mm by a syringe pump; the droplets fall on a horizontal surface laying downwards by 5 to 120 cm. The surface can be made of copper or ultrafine sandpaper, either dry or wetted by one previous droplet. Video images are recorded at 200 Hz and analysed to classify the impact outcome. Each test condition is repeated 10 or 20 times for statistical analysis.

Experimental Results

Impact parameter are classified for pure/sparkling water, surface type, impact distance, first or second drop (dry/wet).

Impact outcomes are reported in the following tables, where the statistical results are highlighted by a coloured background whose intensity is proportional to each outcome probability.

When impacting on the copper flat surface, differences are negligible (results are not presented). When impacting on the ultrafine sandpaper (P10000), differences appears mostly in the recession after impact, that is present for pure water, while sparkling droplets do not recede after their impact and remain pinned to the surface to their larger spreading.

Quote[m]		N	Deposition	Spreading	Spreading +Receding	Spreading +Receding + Break Up	Prompt Splash	Prompt Splash +Receding	Prompt Splash +RBU	Corona	Corona +Receding	Corona +RBU	Corona splash	Corona splash +Receding	Corona Splash +RBU
Acqua Demineralizzata, P10000															
0.05		10													
Goccia 1			100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Goccia 2			100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
0.075															
Goccia 1															
Goccia 2															
0.1		20													
Goccia 1			0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Goccia 2			0%	0%	0%	0%	0%	0%	0%	0%	10%	45%	0%	10%	35%
0.15		20													
Goccia 1			0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Goccia 2			0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	30%	70%
0.2		20													
Goccia 1			0%	0%	15%	0%	0%	85%	0%	0%	0%	0%	0%	0%	0%
Goccia 2			0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	30%	70%
0.3		20													
Goccia 1			0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%
Goccia 2			0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	75%	25%
0.4		20													
Goccia 1			0%	0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%
Goccia 2			0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%

Acqua Gasata, P10000															
Quote[m]	N	Deposition	Spreading	Spreading +Receding	Spreading +Receding + Break Up	Prompt Splash	Prompt Splash +Receding	Prompt Splash + RBU	Corona	Corona +Receding	Corona +RBU	Corona splash	Corona splash +Receding	Corona Splash +RBU	
0.05	10														
Goccia 1		100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Goccia 2		100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
0.075															
Goccia 1															
Goccia 2															
0.1	10														
Goccia 1		0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Goccia 2		0%	0%	0%	0%	0%	0%	0%	40%	0%	0%	60%	0%	0%	0%
0.15	10														
Goccia 1		0%	60%	0%	0%	40%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Goccia 2		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%
0.2	10														
Goccia 1		0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Goccia 2		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%
0.3															
Goccia 1															
Goccia 2															
0.4	10														
Goccia 1		0%	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Goccia 2		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	0%	0%	0%

Conclusion

It is evident that the dissolved CO2 influences the droplet impact outcome in some specific conditions, while in other conditions its presence has no evident effect. These results foster for further study on sparkling droplet impact.